Activity 28

Objective

To multiply a fraction by a number [say, $\frac{3}{4} \times 7$]

Material Required

Buttons (50 pieces) only.

Method of Construction

1. Take seven boxes each containing 4 balls (Fig.1).

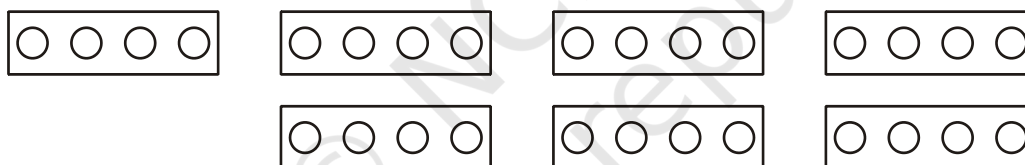



Fig. 1

2. Take out 3 balls from each box (Fig. 2).

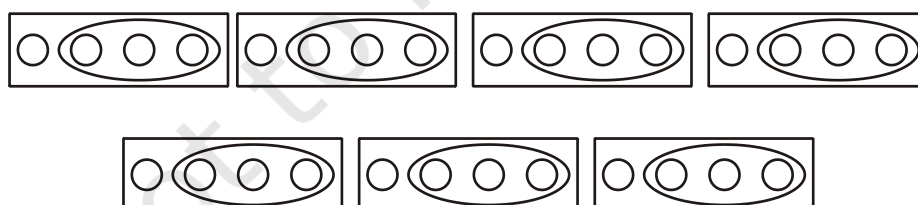



Fig. 2

Demonstration

1. In each box, the 3 balls taken out represent the fraction $\frac{3}{4}$.

2. There are 7 boxes. Thus we have $\frac{3}{4}$ taken 7 times i.e., $\frac{3}{4}$ added 7 times or $\frac{3}{4} \times 7$.

3. Total number of balls taken out from 7 boxes = 21.

   Each remaining ball represents the fraction $\frac{1}{4}$.

   So, fraction represented by 21 balls = $\underbrace{\frac{1}{4}+\frac{1}{4}+......+\frac{1}{4}}_{21 \text{ times}}$.

   Thus, $\frac{3}{4}\times 7 = \frac{21}{4}$.

Observation

Number of balls in one box = _________.

Fraction representing 1 ball = ________.

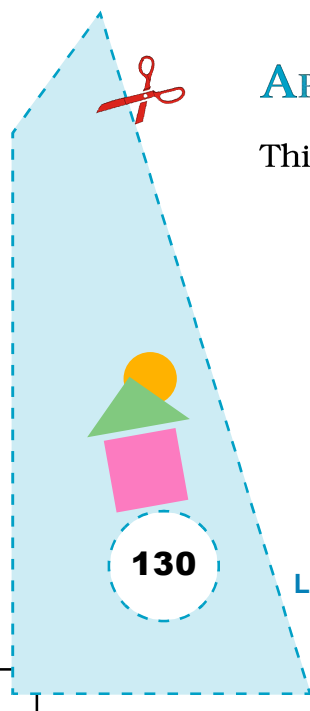
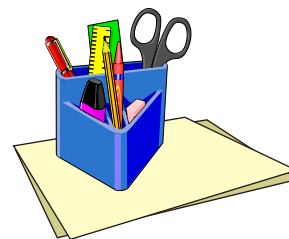
Fraction representing 3 balls in a box = __________.

Total number of balls taken out from 7 boxes represents $\frac{3}{4}$ × _____.

Fraction represented by total number of balls taken out = ______.

So, $\frac{3}{4}$ × _____ = $\frac{\quad}{4}$.

Application

This activity is useful in explaining multiplication of a fraction by a number.

Activity 29

Objective

To divide integers using unit squares of different colours

Materials Required

Cardboard, white paper, red and blue grid paper, colour pens/pencils (Red and Blue), adhesive, ruler, scissors.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Take a blue grid paper and cut out sufficient number of square pieces of unit squares. Let each square represent an integer '+1' (Fig.1).

Fig. 1

3. Take a red grid paper and cut out sufficient number of square pieces of unit area. Let each square represent an integer '–1' (Fig. 2).

Fig. 2

4. Paste one blue unit square and one red unit square together back to back so that one side of the square is blue and the other is red.

I. Positive integer divided by a positive integer, 6 ÷ 2

1. Take 6 blue squares and arrange them in a row as shown in Fig. 3.

Fig. 3

2. Divide these blue squares into two groups taking one by one as shown in Fig. 4.

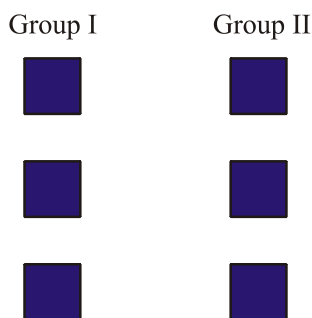



Fig. 4

3. Each group contains 3 blue squares. So, 6 ÷ 2 = 3

II. (–6) ÷ 2 (negative integer divided by a positive integer)

4. Take 6 red unit squares and arrange them as shown in Fig. 5.

Fig. 5

5. Now divide the above red squares into two groups taking them one by one [Fig. 6].

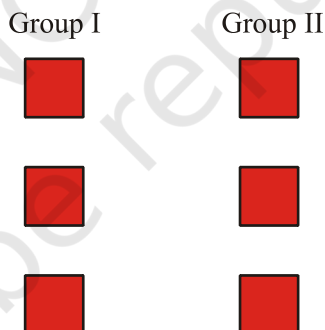



Fig. 6

6. Each group contains 3 red squares. Thus, (– 6) ÷ 2 = – 3.

III. 6 ÷ (–2) (positive integer divided by a negative integer)

7. Take 6 blue unit squares and arrange them in a row as shown in Fig. 7.

Fig. 7

8. Since we have to divide by a negative integer so invert each square of Fig. 7 once (Fig. 8).

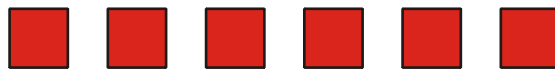



Fig. 8

9. Now divide the above red squares into two groups taking them one by one [Fig. 9].

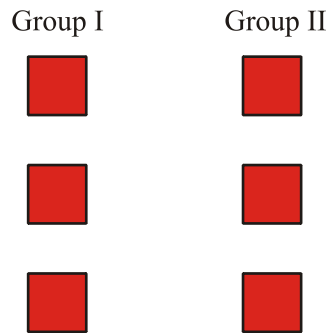



Fig. 9

10. Since each group contains 3 red unit squares so, 6 ÷ (–2) = –3.

IV. (–6) ÷ (–2) (negative integer divided by a negative integer).

11. Take 6 red unit squares and arrange them as shown in Fig. 10.

Fig. 10

12. Since we have to divide by a negative integer, so invert each square of Fig. 10 once (Fig. 11).

Fig. 11

13. Now divide all the squares in Fig. 11 into two groups taking them one by one [Fig. 12].

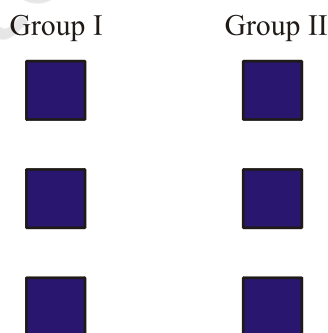
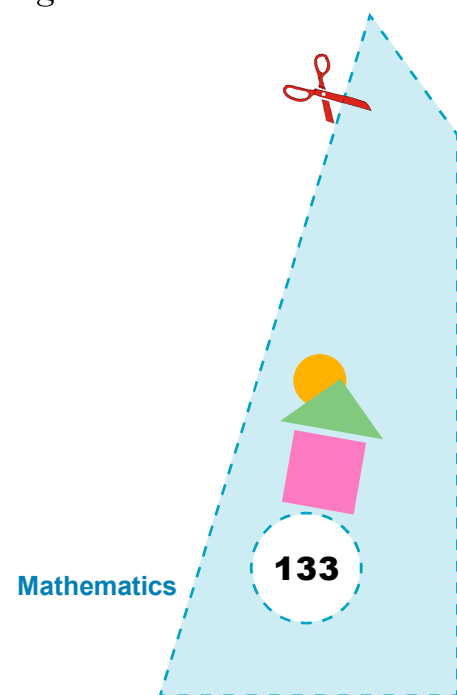



Fig. 12

14. Since each group contains 3 blue squares, so, (–6) ÷ (–2) = 3.

This activity may be performed for finding other quotients such as

6 ÷ 3, –6 ÷ 3, 6 ÷ (–3), (–4) ÷ (–2), –8 ÷ (–4) etc.

Observation

Fill in the blanks:

6 ÷ 2 = ___ 3___.

–6 ÷ 2 = ___ –3___.

6 ÷ (–2) = ___ –3___.

–6 ÷ (–2) = ______.

8 ÷ 4 = ______.

–8 ÷ 4 = ______.

8 ÷ (–4) = ______.

–15 ÷ (–3) = ______.

20 ÷ (–4) = ______.

16 ÷ (–2) = ______.

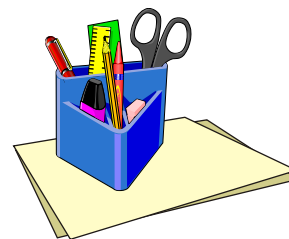
–14 ÷ 2 = ______.

–18 ÷ (–9) = ______.

10 ÷ (–5) = ______.

Application

This activity is useful in explaining division of two integers with same or different signs and to understand rules of division of integers.

Activity 30

Objective

To explain SAS criterion for congruency of two triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of triangles GHI and JKL in which GH = JK, GI = JL and ∠G = ∠J on a glaze paper (Fig. 1) and make cutouts of Δ GHI and Δ JKL.
3. Paste Δ GHI on the cardboard.

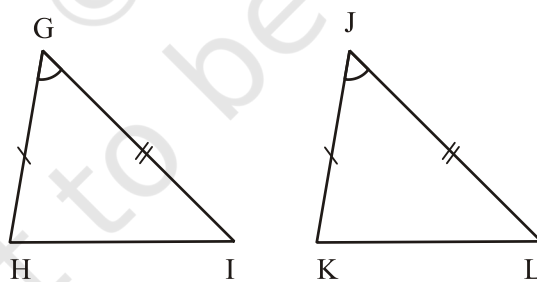



Fig. 1

Demonstration

Superpose the cut out of Δ JKL on Δ GHI and see whether it covers the triangle or not by suitable arrangement. On Δ GHI, Δ JKL covers completely only under the correspondence G ↔ J, H ↔ K, I ↔ L, (Fig. 2).

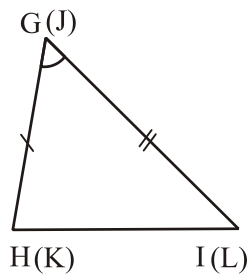



Fig. 2

So, Δ GHI ≅ Δ JKL.

This is SAS criterion for congruency of two triangles.

Observation

On actual measurement:

∠H = ________.　　∠K = ________.

∠I = ________.　　∠L = ________.

HI = ________.　　KL = ________.

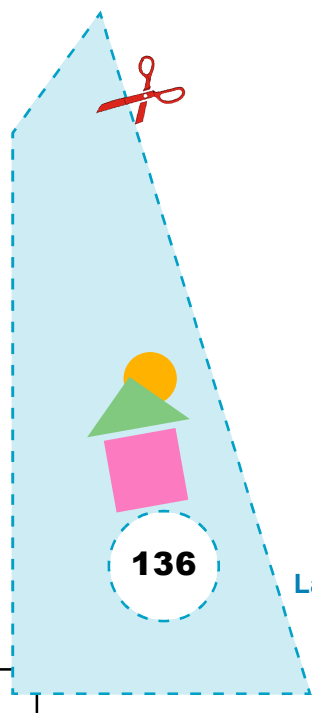
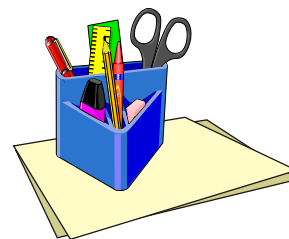
∠H = ∠K

∠I = ∠ ________.

HI = ________.

So, Δ GHI ≅ ________.

Application

This SAS criterion is useful in solving various geometrical problems.

Activity 31

Objective

To explain the SSS criterion for congruency of two triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of triangles ABC and DEF in which AB = DE, BC = EF and AC = DF on a glaze paper and make cutouts of Δ ABC and Δ DEF.
3. Paste Δ ABC on the cardboard.

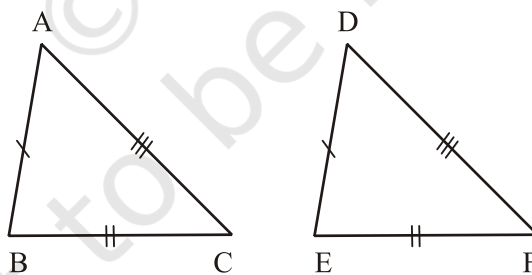



Fig. 1

Demonstration

Superpose the cut out of Δ DEF and see whether one triangle covers the other triangle or not by suitable arrangement. See that Δ DEF covers Δ ABC completely only under the correspondence A ↔ D, B ↔ E, C ↔ F.

So, Δ ABC ≅ Δ DEF.

This is SSS criterion for congruency of two triangles.

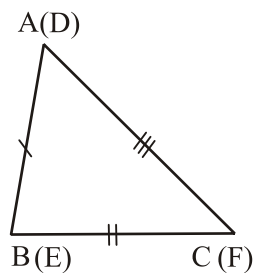



Fig. 2

Observation

On actual measurement in Δ ABC and Δ DEF:

∠A = _________.	∠D = _________.
∠B = _________.	∠E = _________.
∠C = _________.	∠F = _________.

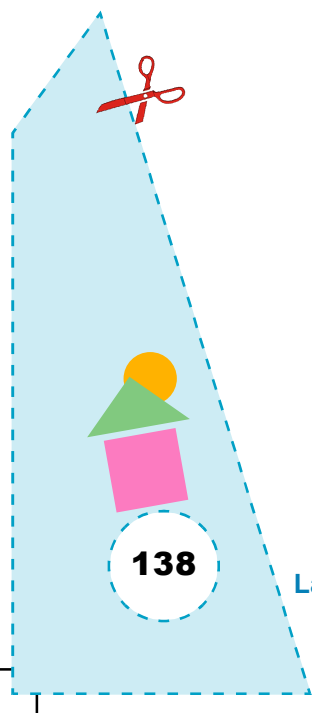
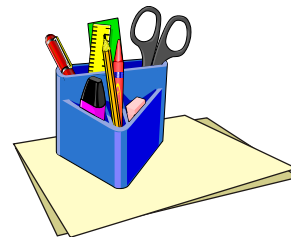
∠A = ∠D

∠B = ∠ _________.

∠C = ∠

So, Δ ABC ≅ _________.

Application

This activity is useful in solving various geometrical problems.

Activity 32

Objective

To explain ASA criterion for congruency of two triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of triangles PQR and STU in which QR = TU, ∠Q = ∠T, ∠R = ∠U on a glaze paper and make cutouts of Δ PQR and Δ STU.
3. Paste Δ PQR on the cardboard.

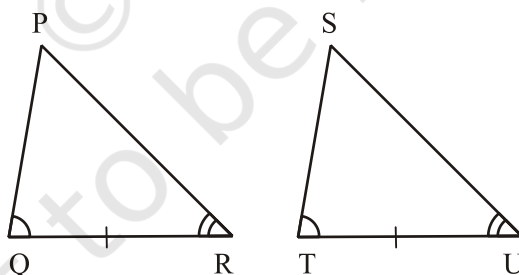



Fig. 1

Demonstration

Superpose the cut out of Δ STU on Δ PQR and see whether it covers the triangle or not by suitable arrangement. See that Δ STU covers Δ PQR completely only under the correspondence P ↔ S, Q ↔ T, R ↔ U. (Fig. 2).

So, Δ PQR ≅ Δ STU.

This is ASA criterion for congruency of two triangles.

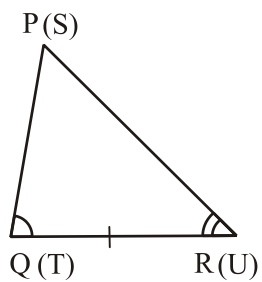



Fig. 2

OBSERVATION

On actual measurement, in Δ PQR and Δ STU:

∠P = ________. ∠S = ________.

PQ = ________. ST = ________.

PR = ________. SU = ________.

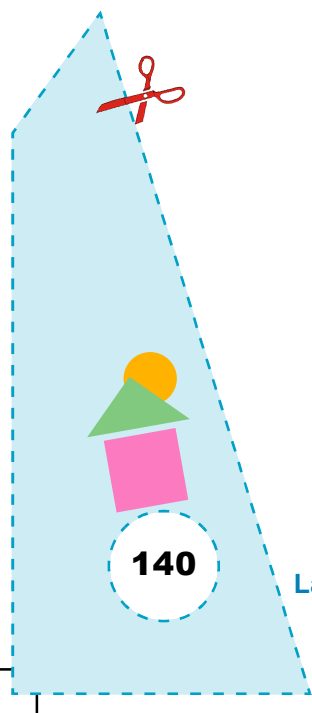
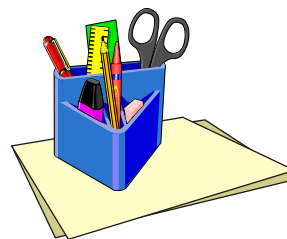
∠P = ∠S

PQ = ________.

PR = ________.

So, Δ PQR ≅ ________.

APPLICATION

This activity is useful in solving of various geometrical problems.

Activity 33

Objective

To explain RHS criterion for congruency of two right triangles

Material Required

Cardboard, cutter, white paper, geometry box, pencil, sketch pens, coloured glaze papers.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a pair of right triangles XYZ and LMN in which hypotenuse YZ = hypotenuse MN and side XZ = side LN on a glaze paper and make cut outs of Δ XYZ and Δ LMN.
3. Paste Δ XYZ on the cardboard.

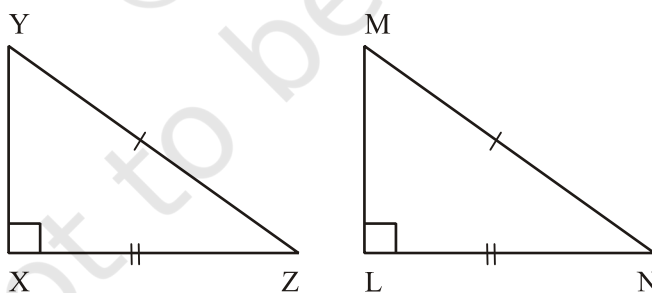



Fig. 1

Demonstration

Superpose the cut out of Δ LMN on Δ XYZ and see whether it covers the triangle or not by suitable arrangement. See that Δ LMN covers Δ XYZ completely only under the correspondence X ↔ L, Y ↔ M, Z ↔ N (Fig. 2).

So, Δ XYZ $\cong$ Δ LMN.

This is RHS criterion for congruency of two triangles.

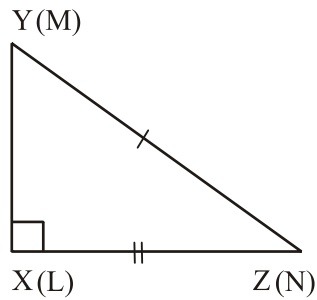



Fig. 2

Observation

On actual measurement, in Δ XYZ and Δ LMN:

$\angle$Y = _________. $\angle$M = _________.

$\angle$Z = _________. $\angle$N = _________.

XY = _________. LM = _________.

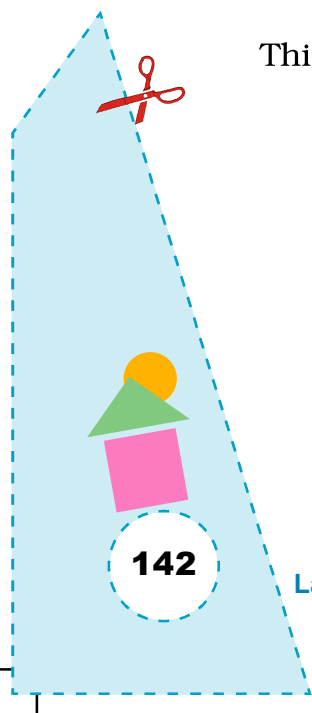
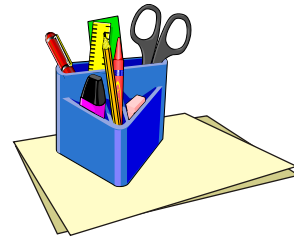
$\angle$Y = $\angle$M

$\angle$Z = $\angle$ _________.

XY = _________.

So, Δ XYZ $\cong$ Δ _________.

Application

This activity is useful in solving various geometrical problems.

Activity 34

Objective

To verify that in an isosceles triangle, angles opposite equal sides are equal

Material Required

Cardboard, white sheet, drawing sheet, different colours, adhesive, scissors, tracing paper, pen/pencil, geometry box.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Draw an isosceles triangle ABC (with AB = AC) on a drawing sheet and cut it out.
3. Colour the three angles of the triangle using different colours as shown in Fig. 1.

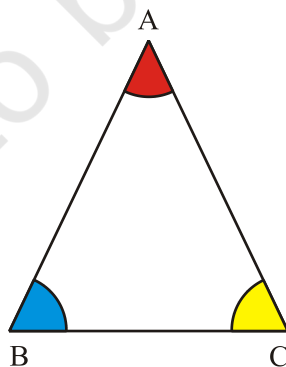



Fig. 1

4. Make a trace copy of the triangle and colour the angles of it exactly the same as the triangle on the board.

5. Make the cutouts of these three angles.

Demonstration

Try to place cutouts of each angle on the other angles of the triangle and see whether it covers the angle or not. Cut out of ∠B should cover exactly ∠C and vice versa.

So, ∠B = ∠C.

Observation

1. Cut out of ∠B covers exactly cut out of ∠ _______.
2. Cut out of ∠C covers exactly cut out ∠ ________.

   Cut out of ∠B does not cover exactly cut out of ∠ _______.

   Cut out of ∠C _______ exactly ∠A.

   Thus ∠B = ∠ _______.

   On actual measurement:

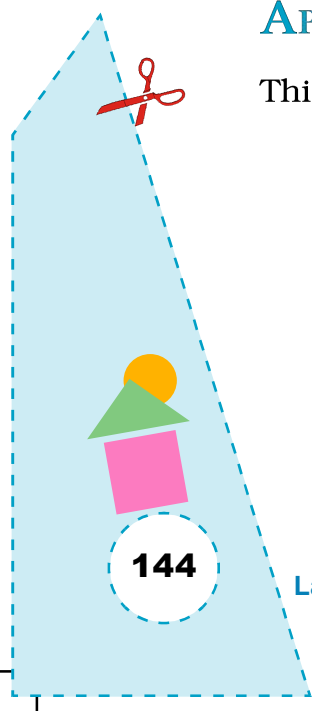
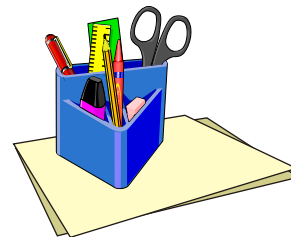
   ∠B = ________.

   ∠C = ________.

   ∠A = ________.

   Thus, in a triangle angles opposite equal sides are _________.

Application

This result is used in solving many other geometrical problems.

Activity 35

Objective

To multiply two fractions (say, $\frac{3}{4}$ and $\frac{5}{6}$)

Material Required

Cardboard, white chart paper, ruler, pencil, eraser, adhesive, sketch pens of different colours (say Blue and Red).

Method of Construction

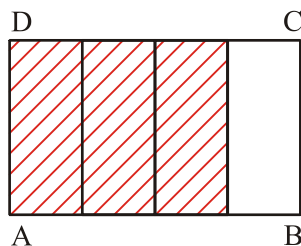
1. Take a cardboard of convenient size and paste a white paper on it.

2. Draw a rectangle ABCD of suitable dimensions (say 8 cm × 3 cm) as shown in Fig.1 on the cardboard.

Fig. 1

3. Divide the rectangle ABCD into 4 equal parts (say along the length) and shade 3 parts in red colour using a sketch pen as shown in Fig. 2.

Fig. 2

13/04/18

4. Divide the rectangle ABCD along the breadth into 6 equal parts and shade 5 parts in blue colour as shown in Figure 3.

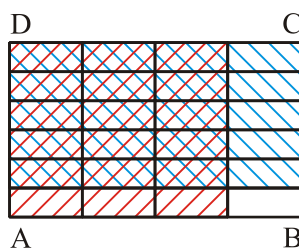



Fig. 3

Demonstration

1. In Fig. 2, portion shaded in red colour represents the fraction $\frac{3}{4}$.

2. In Fig. 3, portion shaded in blue colour represents the fraction $\frac{5}{6}$.

3. In Fig.3, portion shaded in both red and blue colour represents the fraction $\frac{15}{24}$. It also represents $\frac{5}{6}$ of $\frac{3}{4}$ or $\frac{5}{6} \times \frac{3}{4}$.

   Thus, $\frac{5}{6} \times \frac{3}{4} = \frac{15}{24}$.

   Repeat this activity for some other pairs of fractions.

Observation

1. In Fig. 2, the number of equal parts along the length = _________.

   In Fig. 2, the number of parts shaded in red = _________.

   Therefore, shaded part in Fig. 2 represents the fraction = _________.

   In Fig. 3, the number of equal parts along the breadth = _________.

   In Fig. 3, the number of parts shaded in blue = _________.

   Therefore, in Fig. 3, shaded part in blue (along the breadth) represents the fraction = _________.

   In Fig. 3, total number of equal parts = _________.
   (along the length and breadth)

In Fig. 3, the number of parts shaded in both blue and red = ________.

Therefore, in Fig. 3, shaded part (in both blue and red) represents the fraction = ________.

Hence $\frac{5}{6} \times \frac{3}{4} = \square$

2. Let the rectangular area of the rectangle ABCD represent unit area.

(i) Area of shaded region in red represents $\square$ of area of rectangle ABCD.

(ii) Area of shaded region in blue represents $\square$ of area of the rectangle ABCD.

(iii) The whole rectangular region in Fig. 3 is divided into $\square$ equal parts and each equal part represents $\square$

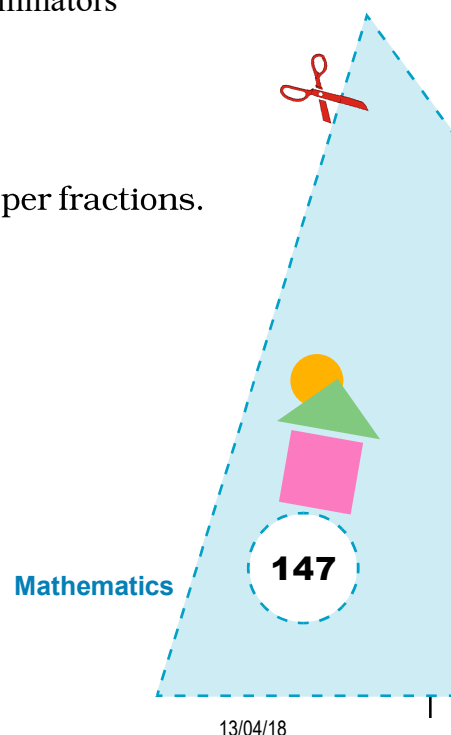
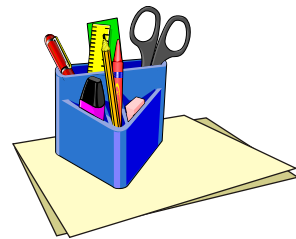
(iv) The area of the double shaded region (in red and blue) represents $\square$ of area of the rectangle ABCD.

The length and breadth of the double shaded rectangular region represents $\frac{3}{4}$ of the length and $\frac{5}{6}$ of breadth of the rectangle ABCD.

Hence $\frac{3}{4} \times \frac{5}{6} =$ ________.

Thus, the product of two fractions = $\frac{\text{Product of their numerators}}{\text{Product of their denominators}}$.

Application

This activity may be used in explaining product of a pair of proper fractions.

Activity 36

Objective

To divide a fraction by another fraction [say, $\frac{2}{3} \div \frac{1}{6}$]

Material Required

White paper sheet, colour pen/pencils, eraser etc.

Method of Construction

1. Draw a rectangle on a paper and divide it into three equal parts (Fig. 1).

Fig. 1

2. Again divide each smaller rectangle (cell) into two equal parts and get six smaller equal parts (Fig. 2).

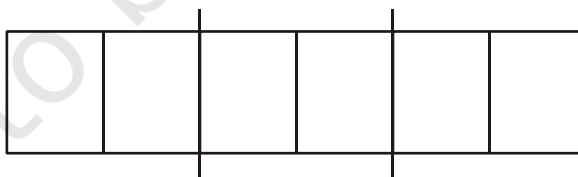



Fig. 2

Demonstration

1. Each part of the rectangle in Fig.1, represents the fraction $\frac{1}{3}$.

   So, fraction $\frac{2}{3}$ is represented by two equal parts (Fig. 3).

13/04/18

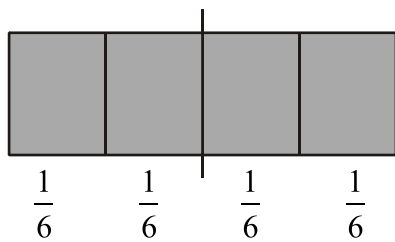
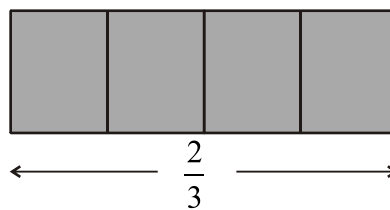



Fig. 3

Fig. 4

2. Each part in Fig. 2, represents the fraction $\frac{1}{6}$.

3. Take two equal parts of Fig. 2, we get Fig. 3. $\frac{2}{3} \div \frac{1}{6}$ means, the number of $\frac{1}{6}$ that are contained in $\frac{2}{3}$.

4. There are four $\frac{1}{6}$ in $\frac{2}{3}$ (see Fig. 4).

   So, $\frac{2}{3} \div \frac{1}{6} = 4$

Observation

In Fig. 1, each part represents the fraction = _______.

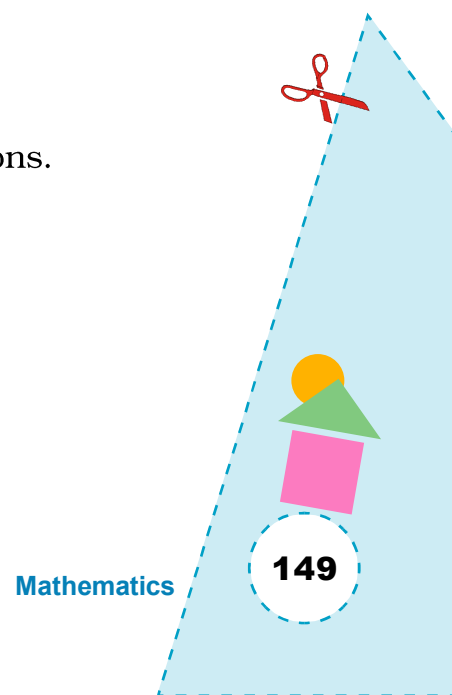
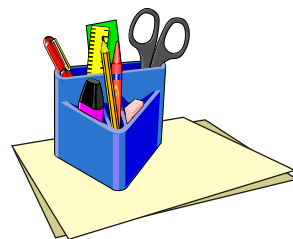
In Fig. 1, two parts represents the fraction = _______.

In Fig. 2, each part represents the fraction = _______.

In Fig. 4, number of $\frac{1}{6}$ = _______.

So, _______ = _______.

Application

This activity is useful in explaining the division of two fractions.

Activity 37

Objective

To divide a fraction by a natural number. [say, $\frac{1}{3} \div 4$]

Material Required

White paper sheet, colour pens/pencils, eraser etc.

Method of Construction

1. Draw a rectangle on a paper and divide it into 3 equal parts (Fig. 1).

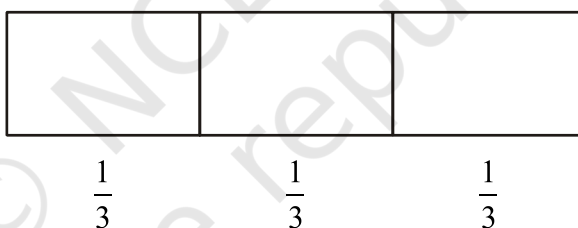



Fig. 1

2. Again divide each smaller rectangle (cell) into four equal parts and obtain 12 smaller equal parts (Fig. 2).

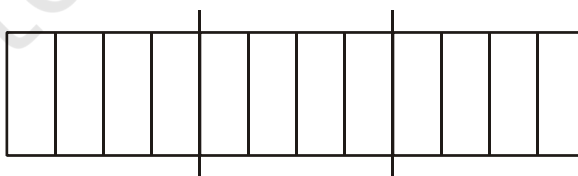



Fig. 2

Demonstration

1. Each part, in the rectangle in Fig.1, represents the fraction $\frac{1}{3}$.

2. Each part of Fig. 2, has been obtained on dividing $\frac{1}{3}$ into 4 equal parts.

   So, each part in Fig. 2 represents $\frac{1}{3} \div 4$.

3. Each part in Fig. 2 represents the fraction $\frac{1}{12}$.

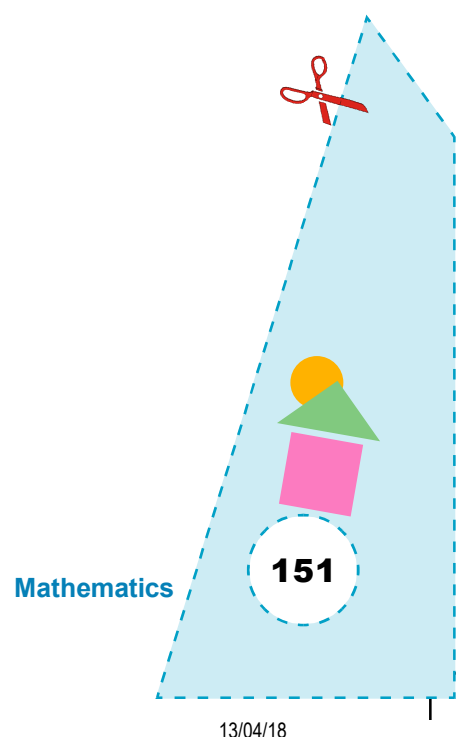
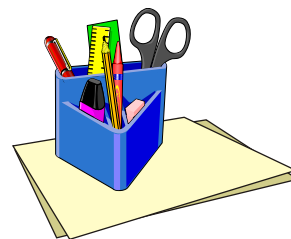
   Thus, $\frac{1}{3} \div 4 = \frac{1}{12}$.

Observation

1. Each part of Fig.1 represents the fraction = ________.
2. Each part of Fig. 2 represents the fraction = _______.
3. Each part of Fig. 2 is obtained on dividing _______ by _______.
4. So, $\frac{1}{3} \div 4 =$ _______.

Application

This activity is useful in explaining division of a fraction by a natural number.

13/04/18

Activity 38

Objective

To multiply integers using unit squares of different colours

Material Required

Cardboard, white paper, red and blue grid papers, colour pens (Red and Blue), adhesive, ruler, scissors.

Method of Construction

1. Take a cardboard of a convenient size and paste a white paper on it.

2. Take a blue grid paper and cut out sufficient number of square pieces of unit squares. Each blue square represents an integer '+1' (Fig. 1).

Fig. 1

3. Take a red grid paper and cut out sufficient number of square pieces of unit area. Let each red square represent an integer '–1' (Fig. 2).

Fig. 2

4. Paste one blue unit square and one red unit square together so that one side of the square is blue and the other is red.

Demonstration

I. For two positive integers, say 2 × 3.

1. Draw 5 (= 2 + 3) blue edges of unit length on this cardboard as shown in Fig. 3.

2. Complete the rectangular shape using blue unit squares as shown in Fig. 4.

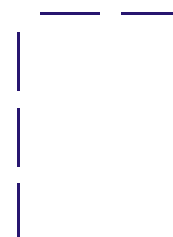



Fig. 3

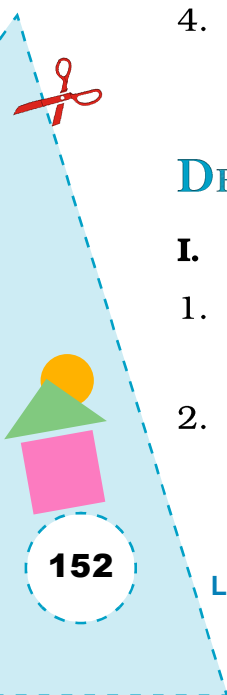
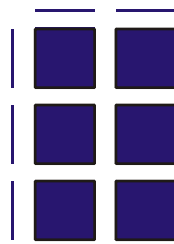



Fig. 4

3. Number of blue unit squares in the rectangle is 6. Thus, 2 × 3 = 6.

II. For one negative and one positive integer, say (–2) × 3.

4. Draw 3 blue edges and 2 red edges each of unit length using coloured pen as we have to multiply (–2) by (3) [Fig. 5].

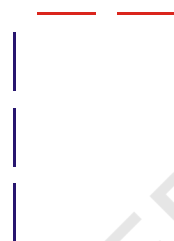



Fig. 5

5. Complete the rectangle in Fig. 5 using blue unit squares [Fig. 6].

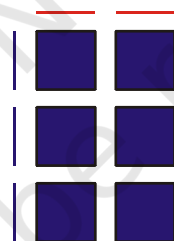



Fig. 6

6. Since one side of the rectangle has red edges, so invert each blue square of Fig. 6 once as shown in Fig. 7.

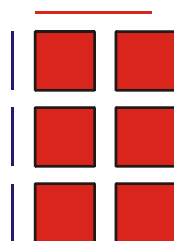
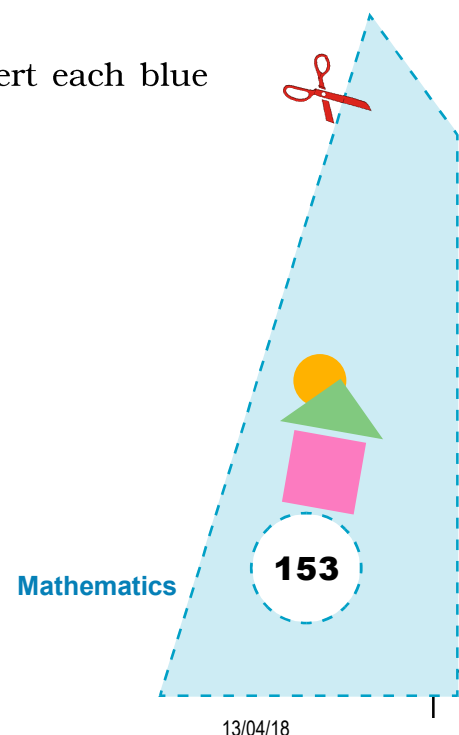



Fig. 7

7. In Fig.7, there are six red unit squares.

So, $(-2) \times 3 = -6$.

III. For two negative integers, say, $(-2) \times (-3)$.

8. Draw 5 red edges each of unit length as shown in Fig. 8 as we have to multiply (-2) by (-3).

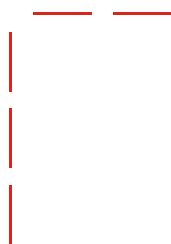



Fig. 8

9. Complete the rectangle in Fig. 8 using blue unit squares [Fig. 9].

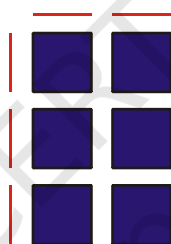



Fig. 9

10. Since two sides of the rectangle in Fig. 9 are having red edges, so invert the squares, two times as shown in Fig. 10 and 11.

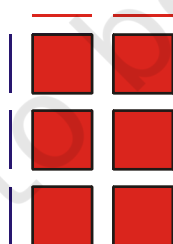



Fig. 10

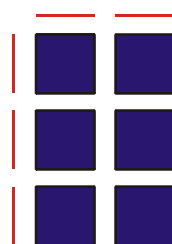



Fig. 11

11. There are now, 6 blue squares in the rectangle.

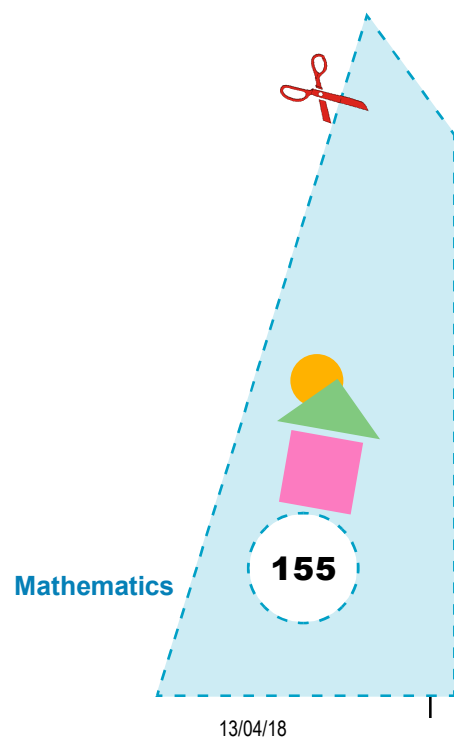
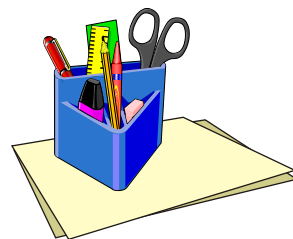
So, $(-2) \times (-3) = 6$

This activity may be performed for finding other products such as $(-4) \times 3$, 4×3, $(-3) \times (5)$ etc.

OBSERVATION

2 × 3	= __6___.
–2 × 3	= __–6___.
(–2) × (–3)	= _____.
4 × 3	= _____.
–4 × 4	= _____.
(–3) × (–5)	= _____.
(–9) × (–10)	= _____.
–7 × 4	= _____.
–5 × (–6)	= _____.

APPLICATION

This activity is useful in explaining multiplications of two integers with same / different signs and to understand rules of multiplication of integers.

Activity 39

Objective

To divide a natural number by a fraction

Material Required

Chart paper, sketch pens, ruler, pencil, adhesive, cardboard.

Method of Construction

Let us find $2 \div \frac{1}{4}$.

1. Take a cardboard of a convenient size and paste a chart paper on it.
2. Cut out 2 rectangles of same size from the cardboard (Fig.1).

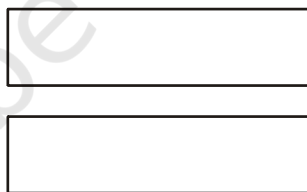



Fig. 1

3. Divide each rectangle to form equal parts as shown in Fig. 2.

Fig. 2

Demonstration

1. There are two identical rectangles each representing natural number 1.

Thus the two rectangles together represent the natural number 2.

2. Each rectangle has been divided into 4 equal parts. So, each part in a rectangle represents the fraction $\frac{1}{4}$.

3. There are in all eight $\frac{1}{4}$'s in Fig. 2 i.e., Fig. 2 contains eight $\frac{1}{4}$.

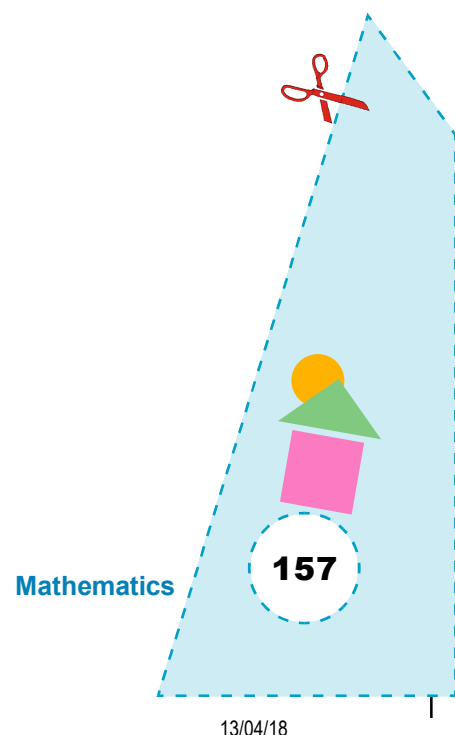
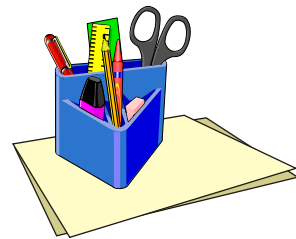
   Thus $2 \div \frac{1}{4} = 8$ (or $2 \times \frac{4}{1}$).

This activity can be performed by taking different natural numbers and fractions, such as $3 \div \frac{1}{4}$, $4 \div \frac{1}{5}$, $6 \div \frac{1}{3}$.

Observation

1. In Fig. 1 each rectangle represents the number ________.
2. In Fig. 2, both rectangles together represent the number ________.
3. In Fig. 2 each part in a rectangle represents ________.
4. In Fig. 2, the number of parts representing $\frac{1}{4}$ is ________.
5. $2 \div \frac{1}{4} =$ ________.

Application

This activity is useful in explaining division of a natural number by a fraction.

Activity 40

Objective

To divide a mixed fraction by a proper fraction [say, $1\frac{3}{4} \div \frac{1}{4}$]

Material Required

Paper, colour pen, eraser, pencil, cardboard, adhesive.

Method of Construction

1. Draw two circles of equal radius on a paper and cut them out and paste on a cardboard.

2. Divide each circle into 4 equal parts as shown in Fig.1.

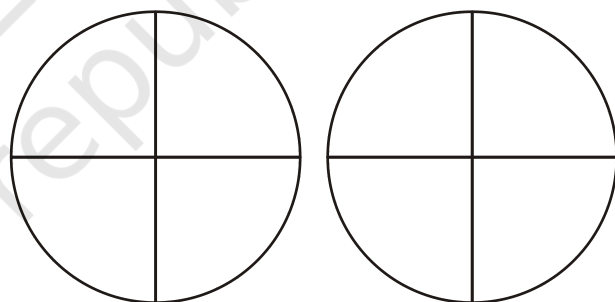
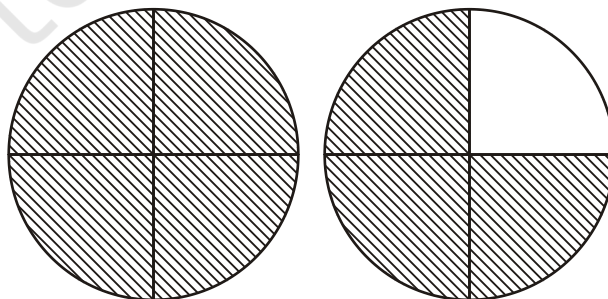



Fig. 1

3. Shade one circle completely and 3 equal parts in other circle (Fig. 2).

Fig. 2

13/04/18

Demonstration

1. Each part in Fig. 1 represents the fraction $\frac{1}{4}$.

2. Shaded portion in Fig. 2 represents mixed fraction $1\frac{3}{4}$.

3. There are seven $\frac{1}{4}$'s in the shaded part in Fig. 2.

   So, $1\frac{3}{4} \div \frac{1}{4} = 7$.

Observation

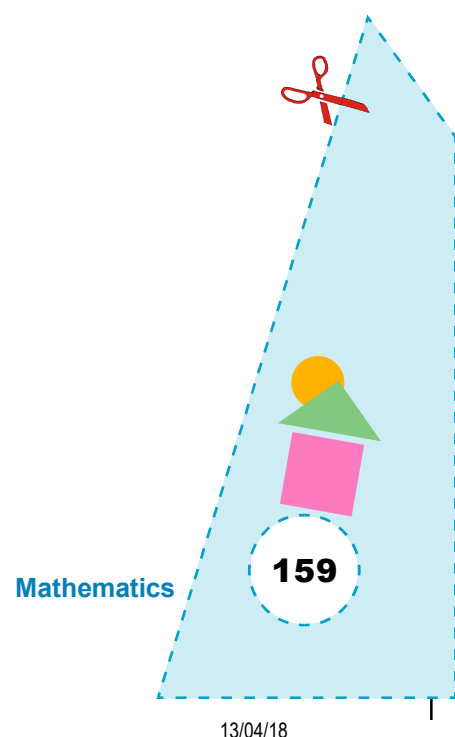
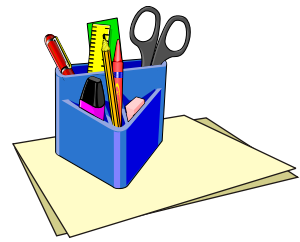
Each part in Fig. I represents the fraction = ______.

In Fig. 2 the shaded portion represents mixed fraction = ______.

There are ______ 's in the shaded portion in Fig. 2.

So, ____ ÷ ____ = ____.

Application

This activity is useful in explaining division of a mixed fraction by a proper fraction.

Activity 41

Objective

To multiply two decimals (say 0.3 and 0.4) using a grid

Material Required

Cardboard, white chart paper, ruler, pencil, eraser, adhesive, sketch pens of different colours.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.
2. Make a 10×10 grid on it and label the corners of the grid as A, B, C and D as shown in Fig. 1.

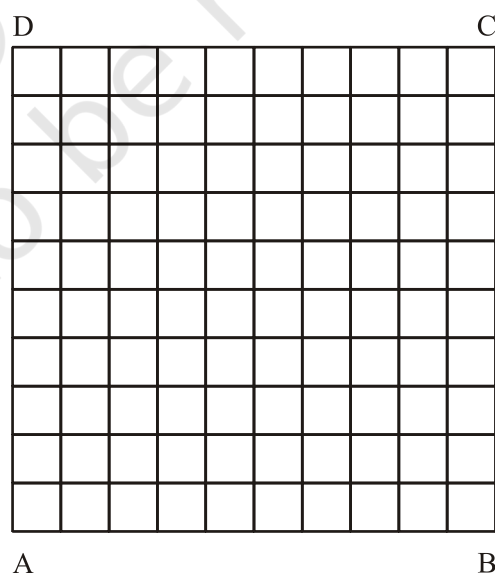
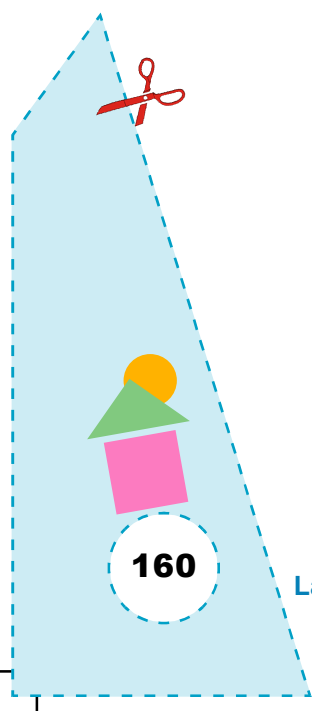



Fig. 1

3. Shade three horizontal strips using a sketch pen of say, red colour starting from the bottom as shown in Fig. 2.

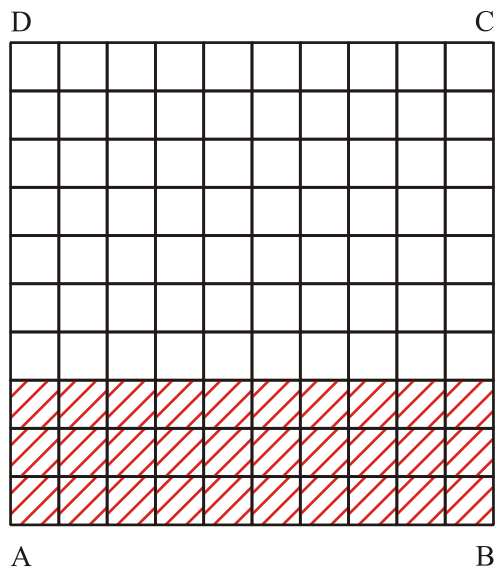



Fig. 2

4. Shade four vertical strips using a sketch pen of say blue colour starting from right most corner as shown in Fig. 3.

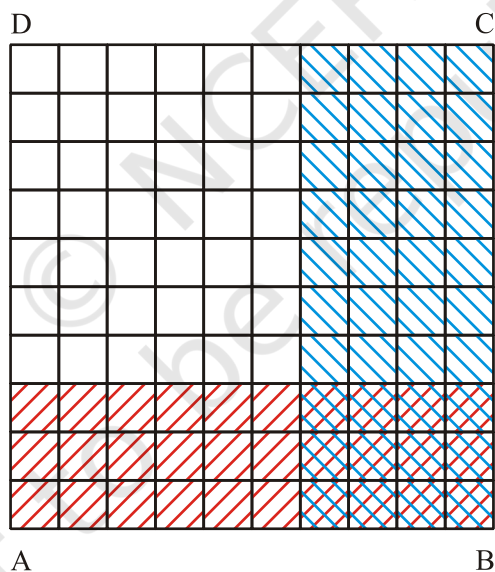
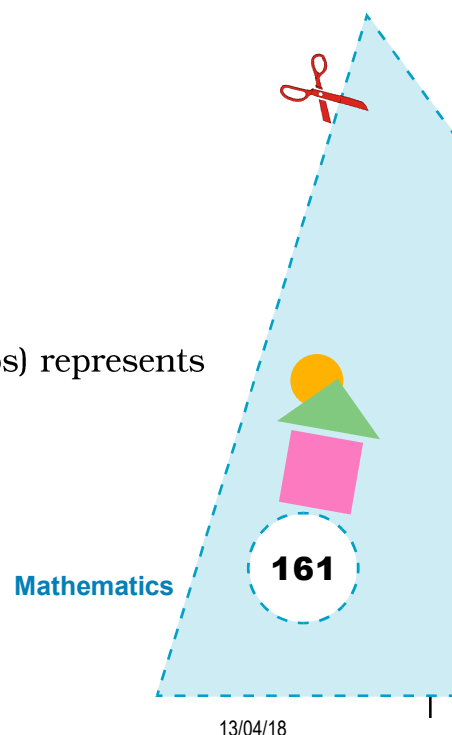



Fig. 3

DEMONSTRATION

1. In Fig. 2, portion shaded in red colour (horizontal strips) represents $\frac{3}{10}$ or 0.3.

2. In Fig. 3, portion shaded in blue colour (vertical strips) represents $\frac{4}{10}$ or 0.4.

3. In Fig. 3, portion shaded both in red and blue colours represents $\frac{12}{100}$ or 0.12.

   Thus, $0.3 \times 0.4 = 0.12$

4. Repeat this activity by taking different numbers of horizontal and vertical strips to represent the product of the pairs of decimals such as

   0.5×0.6, 0.2×0.8, 0.6×0.3, 0.5×0.5 etc.

Observation

In Fig. 2, total number of horizontal strips = __________.
Number of horizontal strips shaded in red = __________.

Therefore, decimal represented by the shaded horizontal strips = __________.

In Fig. 3, total number of vertical strips = __________.

Number of vertical strips shaded in blue = __________.

Decimal represented by the shaded vertical strips = __________.

Total number of small squares in the grid = __________.

Number of squares shaded in both blue and red colour = __________.

Decimal represented by double shaded region = __________.

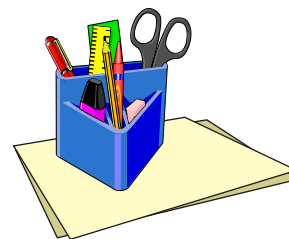
Hence, 0.3×0.4 = __________.

Application

This activity may be used to explain the concept of multiplication of two decimals.

NOTE

1. In Figures 2 and 3, the student may shade the horizontal and vertical strips in any manner not necessarily from bottom.

Activity 42

Objective

To find the value of a^n (where a and n are natural numbers) using paper folding

Material Required

Coloured thin sheets, ruler, pencil, scissors.

Method of Construction

1. Draw a square of convenient size on a coloured thin sheet and cut it out.
2. Fold this sheet one time so that one part exactly covers the other (Fig. 1). This fold divides the sheet into two equal parts.
3. Fold the sheet again as in Step 2 (Fig. 2). This will divide the sheet into 4 equal parts.
4. Continue folding the sheet again and again 4 or 5 times as done in steps 2 and 3.
5. Unfold the sheet.

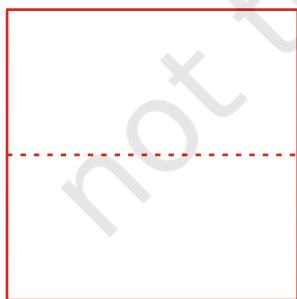
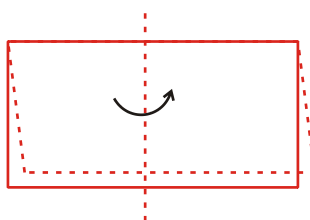
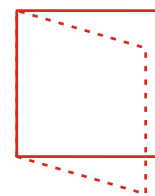



Fig. 1 *Fig. 2* *Fig. 3*

6. Take another sheet and fold it to divide it into 3 equal parts.

7. Again fold the folded sheet into 3 equal parts and so on for 3 or 4 times (Fig. 4).

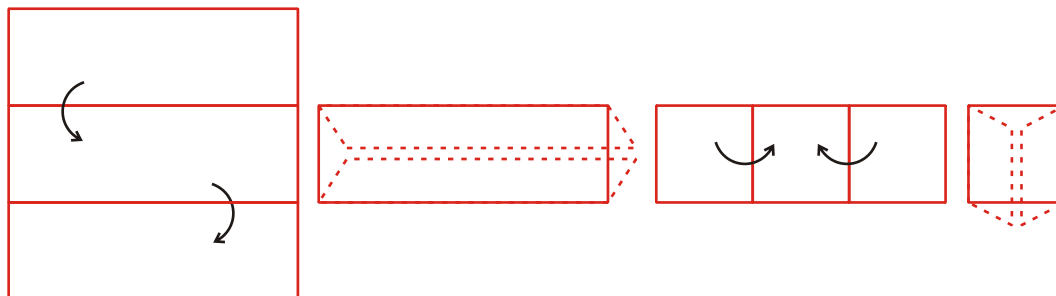



Fig.4

Demonstration

Base (Number of equal parts in which sheet is divided each time)	Number of times sheet is divided	Exponent	Total Number of equal parts (power)
2	0	0	1 (2^0)
2	1	1	2 (2^1)
2	2	2	4 (2^2)
2	3	3	8 (2^3)
3	0	0	1 (3^0)
3	1	1	3 (3^1)
3	2	2	9 (3^2)

Observation

$2^\circ = 1$, 3° = ____, 4° = ____, 5° = ____,

2^1 = ____, 3^1 = ____, 4^1 = ____, 5^1 = ____,

2^2 = ____, 3^2 = ____, 4^2 = ____, 5^2 = ____,

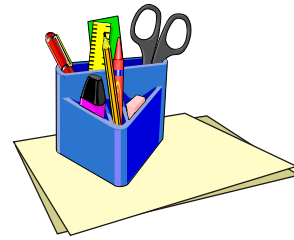
2^3 = ____, 3^3 = ____, 4^3 = ____, 5^3 = ____,

2^4 = ____, 3^4 = ____, 3^5 = ____,

2^4 is called fourth power of 2. 3^5 is called ____ power of ____.

Application

1. This activity can be used to find the power of the base if the number of folds and number of parts the paper is divided is given.
2. This activity can be used to explain the meaning of base, exponent and power.

Activity 43

Objective

To verify exterior angle property of a triangle

Material Required

Drawing sheet, colours, adhesive, scissors, pen/ pencil, cardboard, white paper.

Method of Construction

1. Take a cardboard of convenient size and paste a white paper on it.

2. Make two identical triangles ABC.

3. Colour the angles of the triangles as shown in Fig. 1.

Fig. 1

4. Paste one of the triangles on the cardboard and produce its one side say BC as shown in Fig. 2.

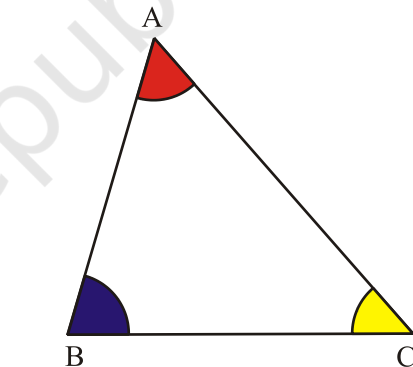
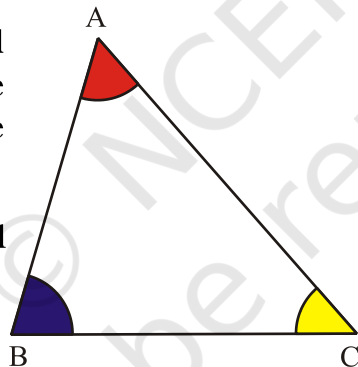
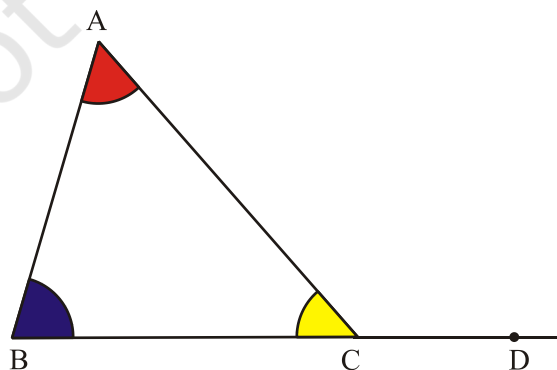
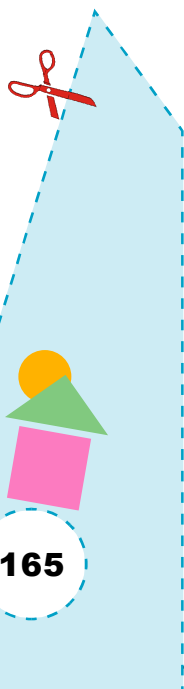



Fig. 2

5. Now cut out the angles A and B from the other triangle (Fig. 3).

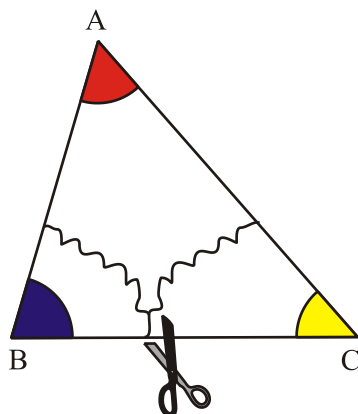



Fig. 3

6. Place the cutouts of ∠A and ∠B on the exterior angle ACD (formed in Fig. 2) as shown in Fig. 4, without leaving any gap between the two angles.

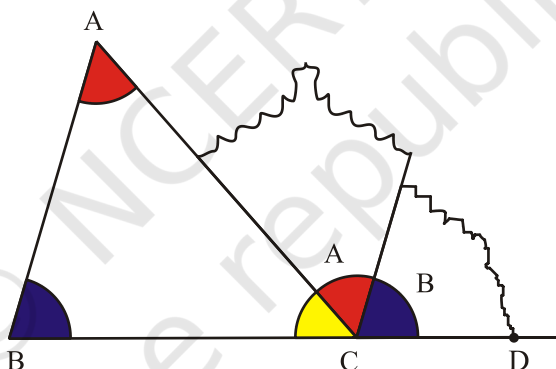



Fig. 4

Demonstration

1. ∠ACD is an exterior angle of Δ ABC.
2. ∠A and ∠B are its two interior opposite angles. These together cover ∠ACD exactly as in Fig. 4.
3. So in Fig. 4, ∠ACD = ∠A + ∠B.

Thus, the exterior angle of a triangle = sum of its two interior angles.

This activity may also be repeated for exterior angles at other vertices.

Observation

On actual measurement

Measure of ∠A =_____.

Measure of ∠B =_____.

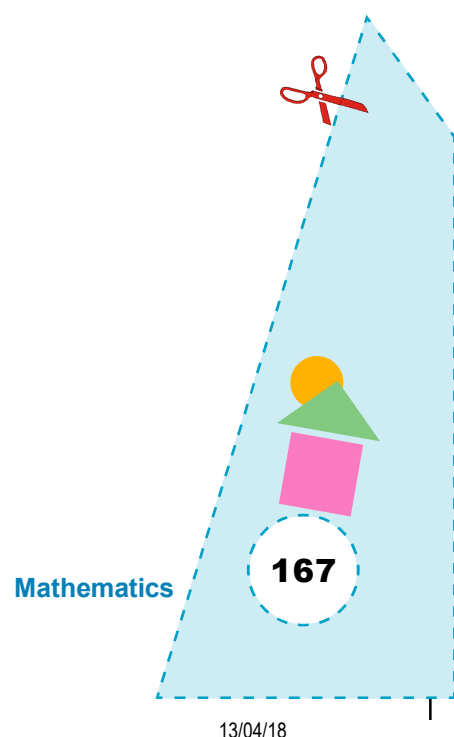
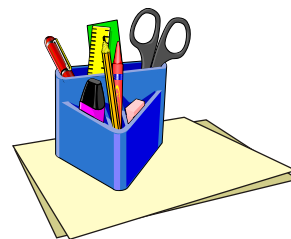
Measure of ∠ACD =_____.

∠ACD = ∠A + ∠ _____.

So, the exterior angle of a triangle is the ______ of its two _____ angles.

Application

This activity can be used to explain:

1. The relationship between an exterior angle and its interior angles.
2. Exterior angle of a triangle if interior angles are given.
3. Unknown interior angle of a triangle if exterior angle is given.

Activity 44

Objective

To verify that the sum of any two sides of a triangle is always greater than the third side

Material Required

Thick sheet, coloured straws, adhesive, a pair of scissors, cardboard, white sheet.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Draw a triangle ABC of any dimension as shown in Fig. 1.

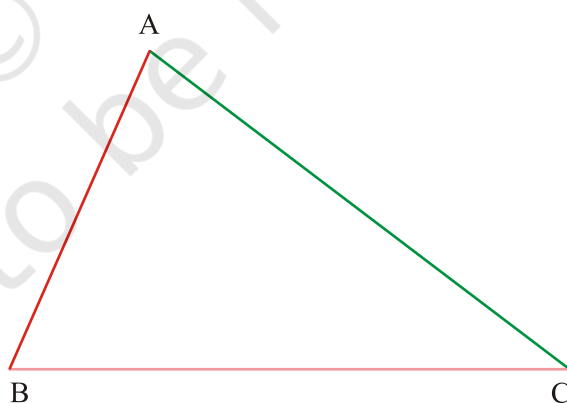
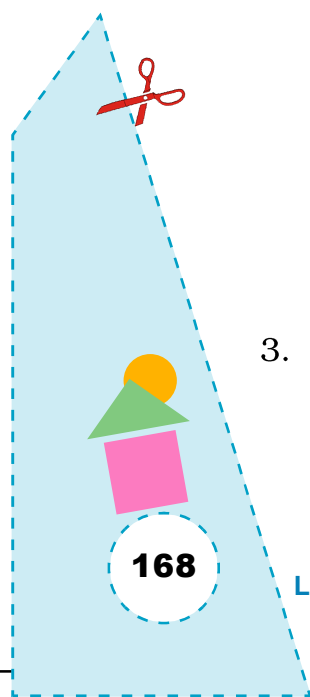



Fig. 1

3. Cut straws of three different colours (say pink, green and red) of the same size as the three sides of the triangle.

4. Paste any two coloured straws in a line leaving no space between them on the cardboard as shown in Fig. 2.

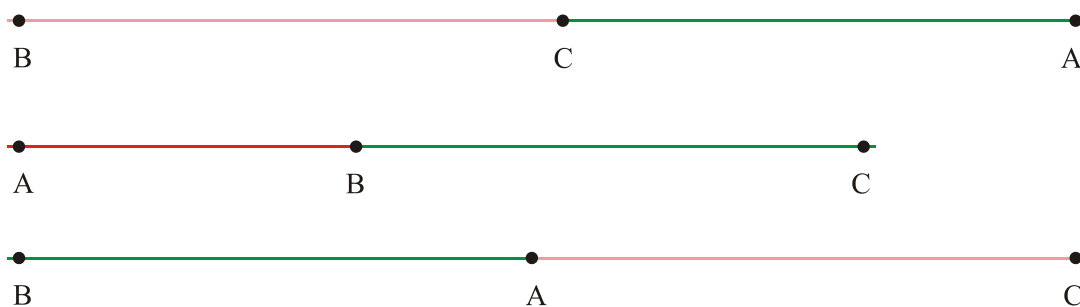



Fig. 2

5. Now paste the left out third straw in each colour on the above two joined straws as shown in Fig. 3.

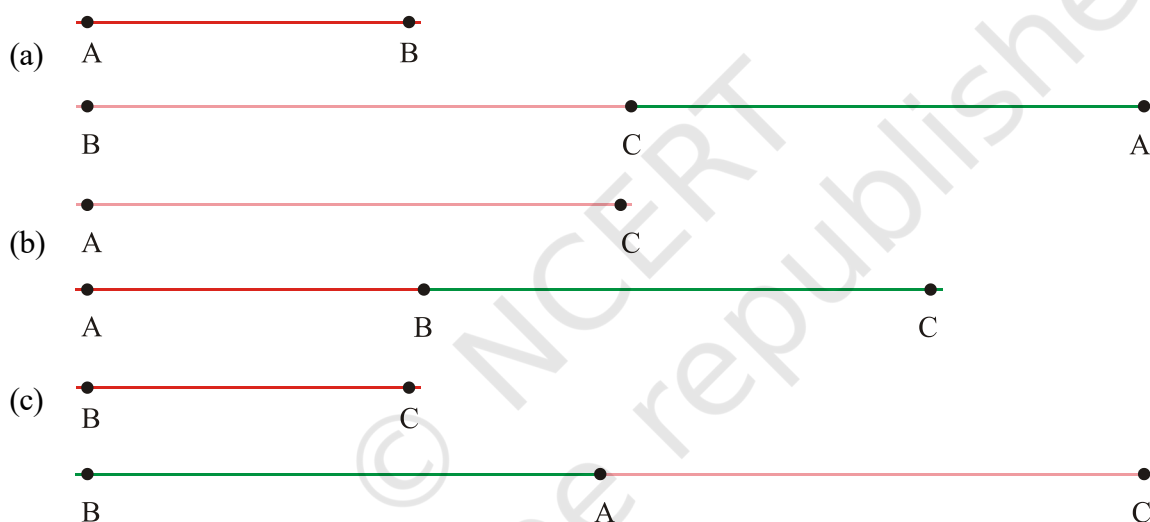



Fig. 3

Demonstration

1. The third straw is always shorter than the two straws combined together in a line in each of the above three cases.

   i.e, BC + AC > AB, AB + BC > AC, AB + AC > BC.

   Sum of any two sides of a triangle is greater than the third side.

OBSERVATION

On actual measurement

AB = ________ cm, BC = ________ cm, CA = ________ cm.

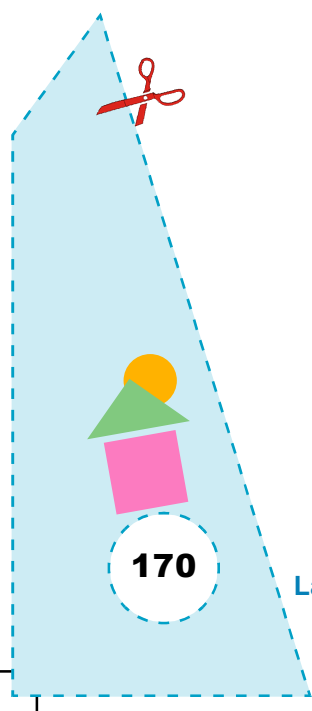
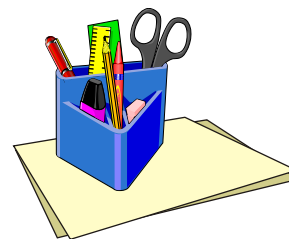
CA + CB = ________ cm, CA + AB = ________ cm, AB + BC = ________ cm.

CA + BC ________ AB.

CA + AB > __________.

AB + BC ________ AC.

APPLICATION

1. This result can be used to know whether a triangle can be constructed with given sides or not.
2. This activity can also be used to verify that the difference of any two sides of a triangle is less than the third side.

Activity 45

Objective

To verify that in a triangle sides opposite equal angles are equal

Material Required

Cardboard, drawing sheet, colours, tracing paper, scissors, pen/pencil, geometry box.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Construct a triangle ABC on a drawing sheet with two of its equal angles say ∠B and ∠C.
3. Colour ∠B as green and ∠C as red [Fig. 1].

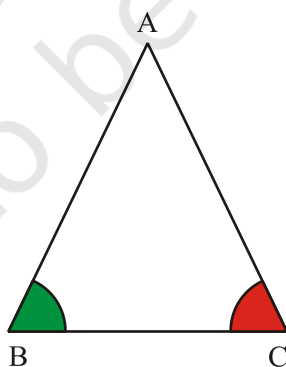
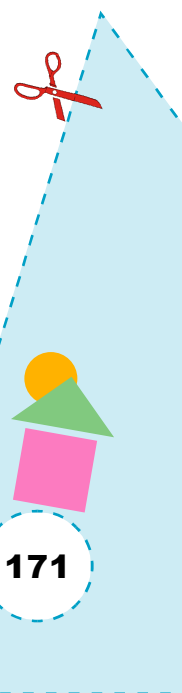



Fig. 1

4. Paste this triangle on the cardboard.
5. Make a trace copy of this triangle using a tracing paper.

Demonstration

Fold the triangle about a line through vertex A such that side BC falls along itself. Vertex B falls on vertex C.

So, side AB covers exactly side AC.

Thus, AB = AC i.e. sides opposite equal angles of a triangle are equal.

Observation

1. Vertex B falls on Vertex ________.
2. Side AB falls on side _________.
3. Side AB covers exactly side ________.
4. On actual measurement, AC = _____, AB = _____, BC = _____.

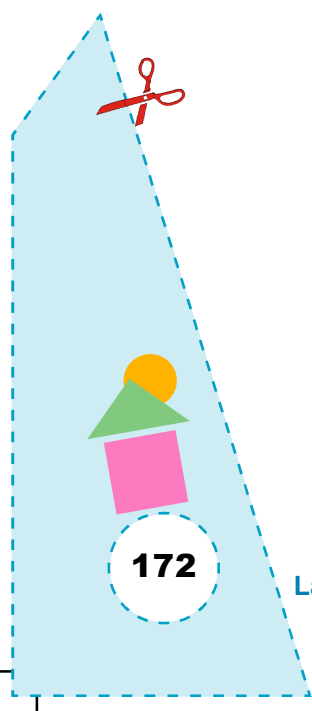
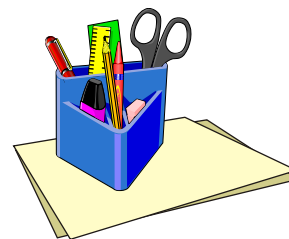
   AB = ______.

   AC = ______.

   AC = ______.

   Thus, in a triangle sides opposite equal angles are ______.

Application

This result is used in solving many geometrical problems.

Activity 46

Objective

To draw altitudes of a triangle using paper folding

Material Required

Transparents/white sheet, coloured paper, scissors, adhesive, pencil.

Method of Construction

1. Make a triangle using paper folding or draw a triangle. It can be of any type, acute angled, right angled or obtuse angled triangle as in Fig. 1.

(i) (ii) (iii)

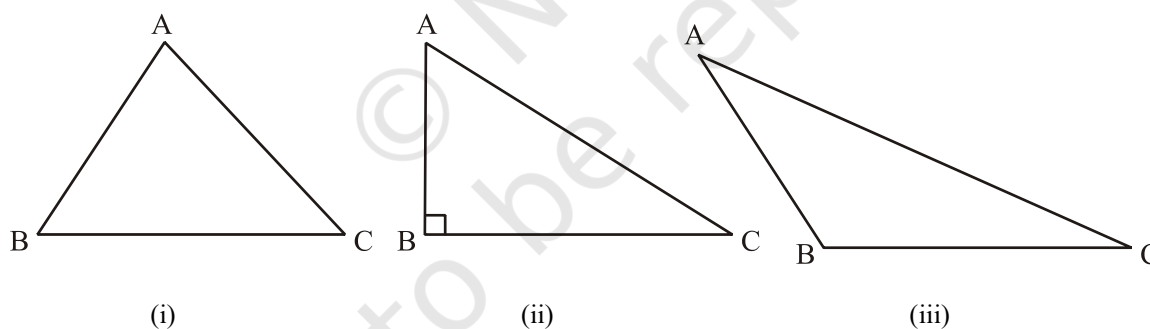



Fig. 1

2. Fold the triangle through A in such a way that BC falls along itself. Unfold and mark the point D where the crease meets BC. Draw a line AD (Fig. 2).

A

B D C

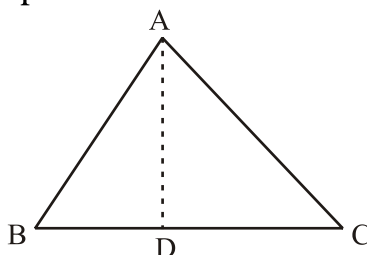



Fig. 2

3. Draw the other two altitudes i.e. from B on AC and from C on AB. Name them as BE and CF, respectively (Fig. 3).

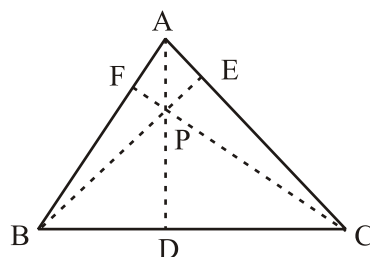



Fig. 3

4. In case of a right triangle, two of its altitudes are the two perpendicular sides AB and BC. The third altitude from B on AC will also pass through the point B.

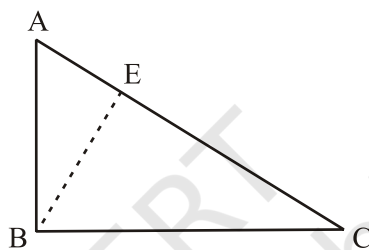



Fig. 4

5. In case of an obtuse angled triangle extend the crease of CB so that altitude from A can be drawn as shown in Fig. 5. Similarly, draw perpendicular from B on AC and from C on AB produced.

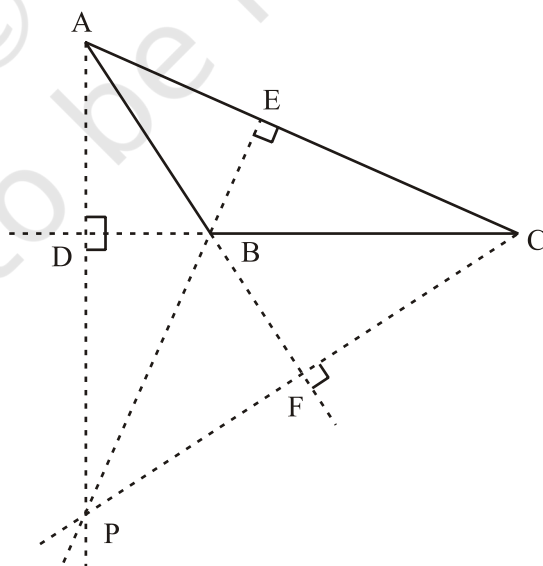



Fig. 5

Demonstration

1. For each triangle, there are 3 altitudes.
2. The altitude of every triangle does not always lie wholly in the interior of the triangle.
3. In an acute angle triangle, the point at which the three altitudes meet, lie in the interior of the triangle.
4. The altitudes of a right angle triangle lies on the triangle and they meet at the vertex of the right angle.
5. The three altitudes of an obtuse angled triangle meet at a point that lies to the exterior of the triangle.

Observation

∠ADC = _____.

∠BEC = _____.

∠CFA = _____.

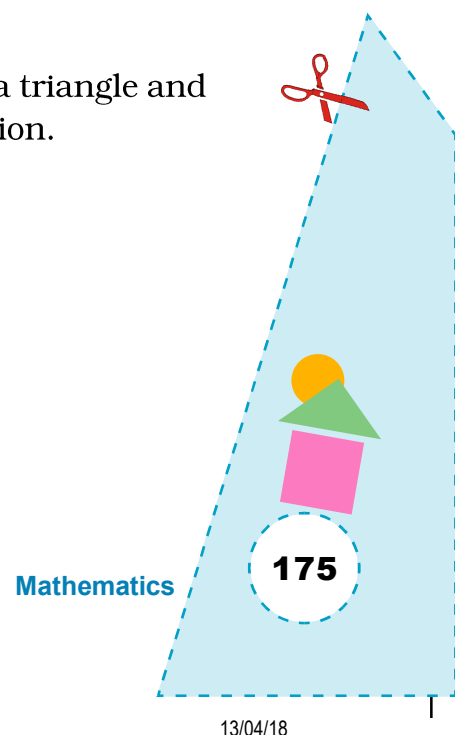
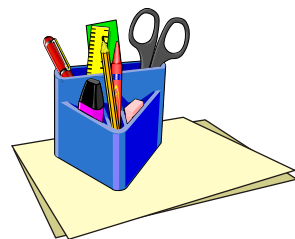
AD is the altitude to side _____.

BE is the _____ of side AC.

_____ is the altitude of side AB.

All the altitudes of a triangle meet at a _____.

Application

This activity can be used to explain the concept of altitude of a triangle and in solving many problems related to geometry and mensuration.

Activity 47

Objective

To find the ratio of circumference and diameter of a circle

Material Required

Geometry box, thick paper, scissors, eraser, pen/ pencil.

Method of Construction

1. Draw a circle on a thick paper and cut it out.
2. Fold it into two halves and obtain a crease. Name the line of folding as AB [Fig. 1].

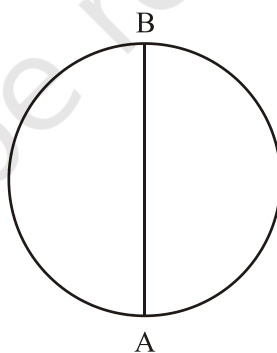



Fig. 1

3. Draw a ray on a paper and mark its initial point as P [Fig. 2].

Fig. 2

4. Hold the circular disc such that point A on the circle coincides with the point P on the ray [Fig. 3].

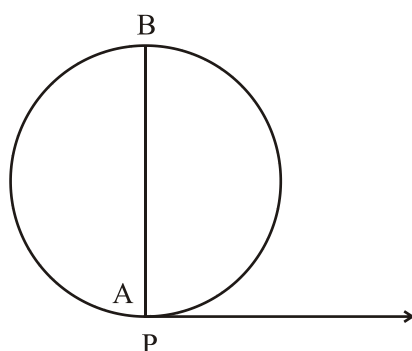



Fig. 3

5. Rotate the circular disc along the ray till the point A again touches the ray. Mark that point on the ray as Q [Fig. 4 (a), 4 (b)].

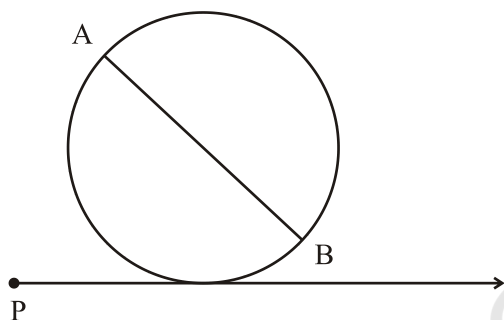
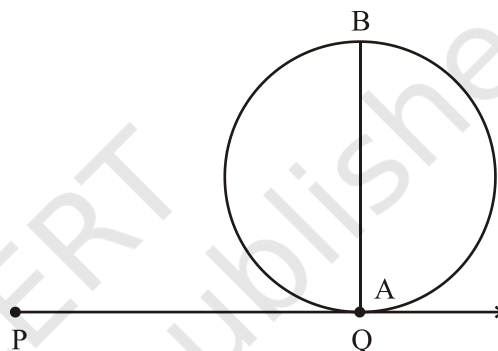



Fig. 4 (a) *Fig. 4 (b)*

6. Repeat the above Steps 4 and 5 for circles of different radii.

Demonstration

1. Line segment AB in Fig.1 is the diameter (d) of the circle.
2. Measure AB.
3. Length PQ is the circumference (c) of the circle.
4. Measure PQ.
5. Find the ratio $\frac{c}{d}$.
6. Repeat the above process for circles of different radii. Each time, the ratio $\frac{c}{d}$ is constant.

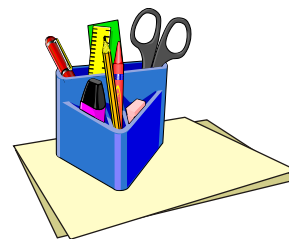
   This constant is denoted by the symbol π. Its value is close to 3.14.

OBSERVATION

Complete the following table:

Circle	Diameter *d*	Circumference *c*	Ratio $= \frac{\text{Circumference}}{\text{Diameter}} = \frac{c}{d}$
1			
2			
3			
4			
:			
:			

Value of $\pi = \frac{c}{d}$ = ________ approximately.

Activity 48

Objective

To understand the meaning of less likely and more likely of the outcomes of an experiment

Material Required

Bag, balls of the same size but of different colours, pen/pencil.

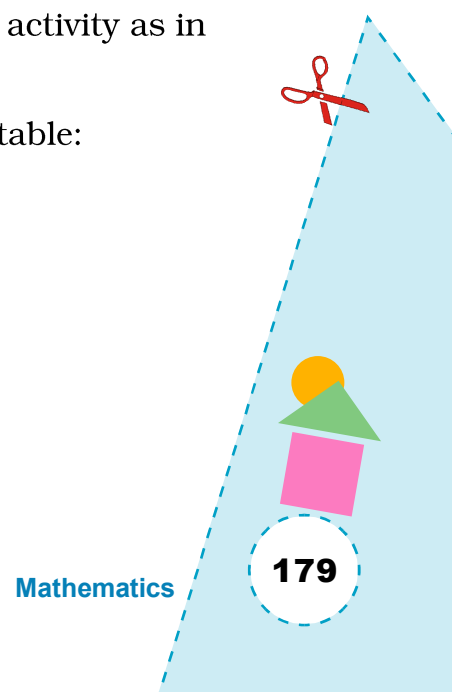
Method of Construction

Take a bag and put say 19 balls of red colour and 6 balls of blue colour in the bag.

Demonstration

1. Draw one ball at a time from the bag without looking into the bag. Note the colour of the ball and put it back into the bag.
2. Let the other students come one by one and repeat this activity as in Step 1.
3. Record the colour of the ball each time in the following table:

Student Name	Colour (Red/Blue)
Rita	____
Arun	____
Vinayak	____
:	____

:   ____

Savita   ____

4. Count the number of times a red colour ball is drawn and also the number of times, a blue colour ball is drawn. Compare the two numbers so obtained.

5. The number of red balls drawn is more than the number of blue balls drawn. So drawing of a red ball is more likely than a blue ball.

Observation

1. Number of times, a red ball is drawn = ____.

2. Number of times, a blue ball is drawn = ____.

   The number in (1) _______ the number in (2).

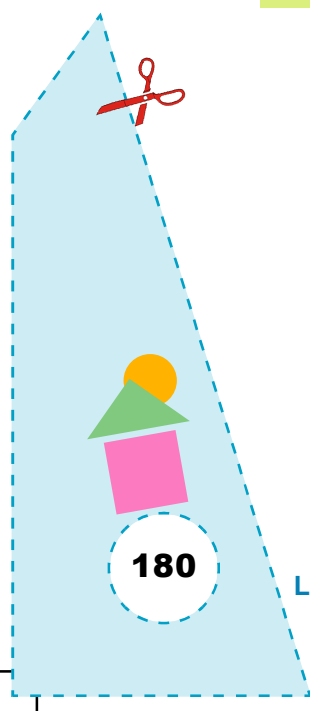
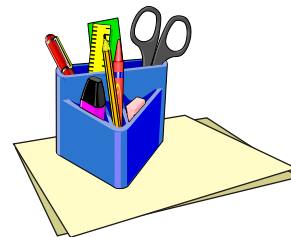
   So, a red ball is more likely than a ______ or a blue ball is _____ than a red ball.

Application

This activity explains the concept of 'less likely' and 'more likely' of outcomes. of a random experiment which is useful in the study of probability.

NOTE

1. This activity may be repeated by placing an equal number of balls of each colour. In this case the chance of drawing a ball of any colour is equally likely when the balls are drawn at random by a sufficient number of students.

13/04/18

Activity 49

OBJECTIVE

To verify that congruent triangles have equal area but two triangles with equal areas may not be congruent

MATERIAL REQUIRED

Graph paper, colours, pen/pencil, scissors.

METHOD OF CONSTRUCTION

1. Take a squared graph paper and make two triangles ABC and PQR each of sides 3 cm, 4 cm and 5 cm as shown in Fig. 1.

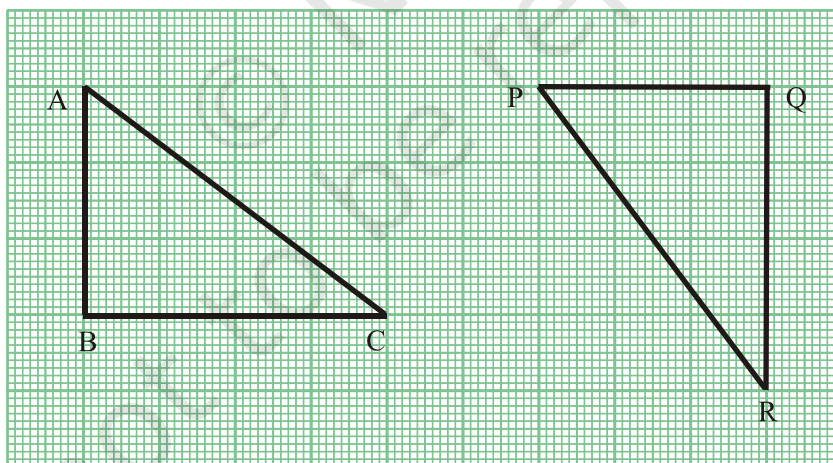



Fig. 1

2. Draw two triangles RST and XYZ (of the same area) as shown in Fig. 2.

3. Make the trace copy of both the triangles of Fig. 1 and Fig. 2 and make their cutouts.

13/04/18

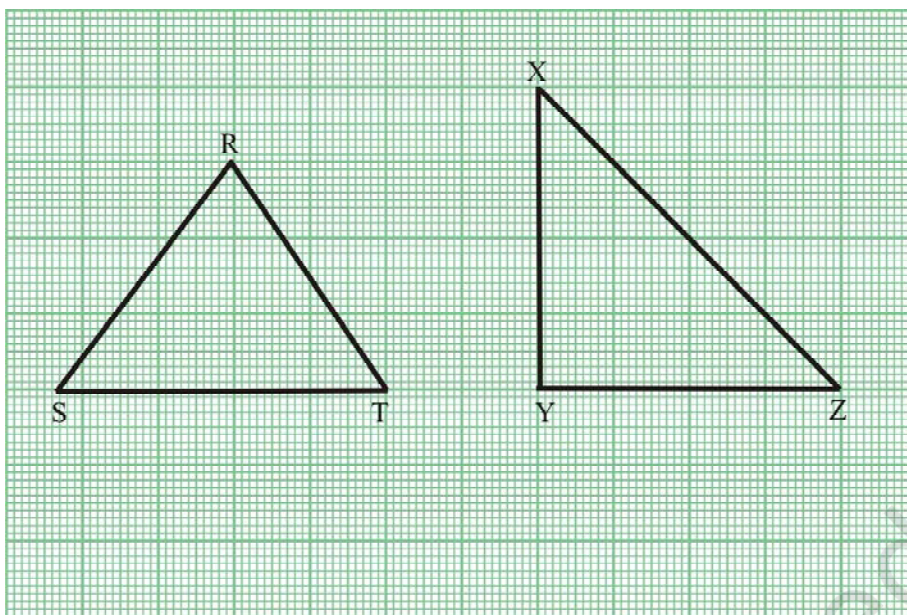



Fig. 2

DEMONSTRATION

1. Place the cut out of Δ PQR over Δ ABC. Cut out of Δ PQR covers the cut out of Δ ABC exactly.
2. So, Δ ABC ≅ Δ PQR.
3. Find the areas of Δ PQR and Δ ABC by counting the number of squares enclosed by them.
4. Area of Δ ABC = Area of Δ PQR = 7 sq. units.

   Thus, congruent triangles have equal areas.
5. Area of Δ RST = 8 sq. units. (By counting the squares).

   Area of Δ XYZ = 8 sq. units (By counting the squares).

   So, the two triangles RST and XYZ are equal in area.
6. Now place the cut out of Δ XYZ over the cut out Δ RST and see if both the cutouts cover each other exactly.

   You can see that they do not cover each other.

   So, the two triangles XYZ and RST are not congruent.

   Thus, two congruent triangles have equal area but two triangles having equal area may not be congruent.

Observation

1. Δ PQR and Δ ABC are _________ triangles.
2. Area of Δ PQR = _________ squares.

   Area of Δ ABC = _________ squares.

   Area of Δ PQR = Area of Δ _______.

   So, congruent triangles have ________ area.
3. Area of Δ RST = _________ squares.

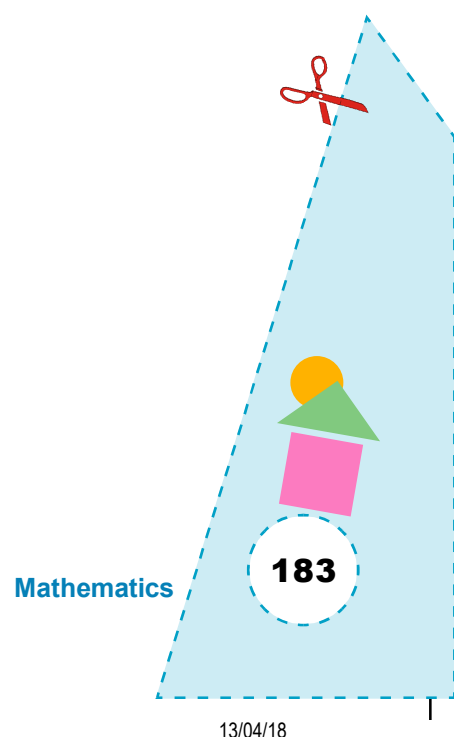
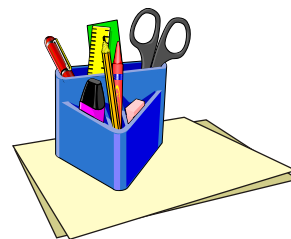
   Area of Δ XYZ = _________squares.

   So, area of Δ RST = area of Δ _______.
4. Δ RST and Δ XYZ do not cover each other _______.

   Δ RST and Δ XYZ are not _______.

Thus, triangles having equal area may not be congruent.

Application

This activity can be used to explain relationship between congruency and areas of different geometric shapes.

Activity 50

Objective

To verify that when two lines intersect, vertically opposite angles are equal

Material Required

Drawing sheet, thumb pins, colour pencil, tracing paper, adhesive, cardboard.

Method of Construction

1. Take a cardboard of convenient size and paste a white sheet on it.
2. Draw a pair of intersecting lines AB and CD as shown in Fig. 1.

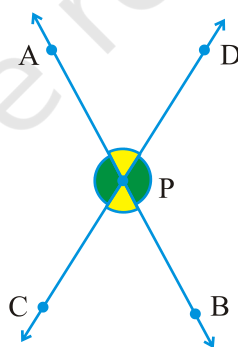



Fig. 1

3. Mark the point of intersection P of these lines.
4. Colour ∠BPC and ∠APD with the same colour, say yellow.
5. Colour ∠BPD and ∠APC with the same colour, say green.

6. Trace Fig.1 on a tracing paper and colour the angles of the figure in the same way as done in Steps 4 and 5.

7. Fix the trace copy on Fig.1 using a thumb pin at the point P, so that the tracing copy can be freely rotated.

Demonstration

1. $\angle$APD and $\angle$BPC are vertically opposite angles, in Fig.1.

2. $\angle$APC and $\angle$DPB are vertically opposite angles, Fig.1.

3. Rotate the trace copy about the point P through an angle of 180°.

4. $\angle$BPC covers $\angle$APD exactly.

   So, $\angle$BPC = $\angle$APD.

5. $\angle$APC covers $\angle$BPD exactly. So, $\angle$APC = $\angle$BPD.

   Thus, vertically opposite angles are equal.

Observation

On actual measurement

$\angle$APC = ________, $\angle$BPD = ________.

$\angle$BPC = ________, $\angle$APD = ________.

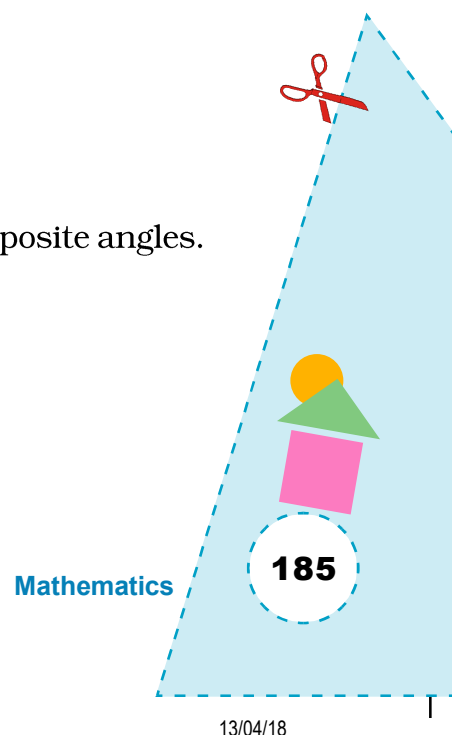
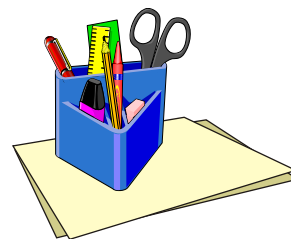
$\angle$APC = $\angle$ _______.

$\angle$ _______ = $\angle$APD.

So, vertically opposite angles are ________.

Application

This activity can be used to explain the meaning of vertically opposite angles.

The result is useful in solving many geometrical problems.

Activity 51

Objective

To find the order of rotational symmetry of a given figure

Material Required

White sheets of paper, geometry box, tracing paper, sketch pen, pencil, adhesive, scissors, board pins.

Method of Construction

1. Let the given figure be of the shape as shown in Fig. 1.
2. Make two copies of the given figure and join the diagonals of the central square in each of the figures. Mark the point of intersection of diagonals as O (Fig. 2). For identification, mark a point P as shown in Fig. 2.

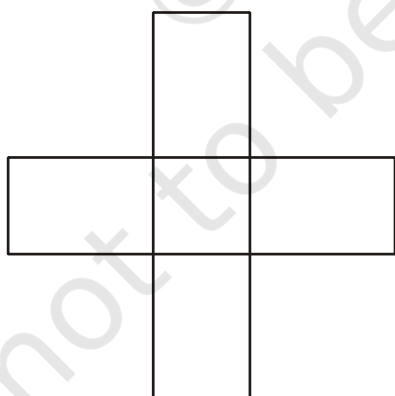
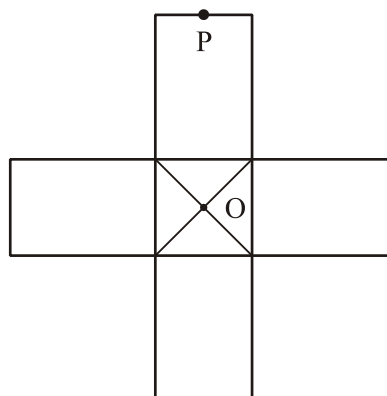



Fig. 1 *Fig. 2*

3. Paste one of them on a cardboard.
4. Place the other figure on the figure pasted on cardboard with the help of a board pin at the point O as shown in Fig. 3.

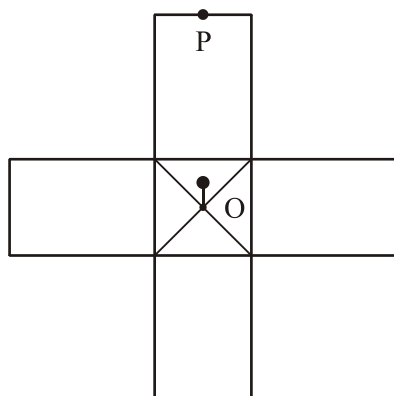



Fig. 3

Demonstration

1. Rotate the upper figure in a clockwise direction about the point O through an angle of 90° (Fig. 4).
2. After a rotation of 90° the upper figure coincides with the original figure.
3. On subsequent rotations of 90°, we obtain Fig. 5, Fig. 6 and Fig. 7, respectively. Each of these figures coincide with the original figure.
4. Thus, the given figure has a rotational symmetry of angles 90°, 180°, 270° and 360°.
5. The figure has a rotational symmetry of order 4.

Fig. 4 *Fig. 5*

13/04/18

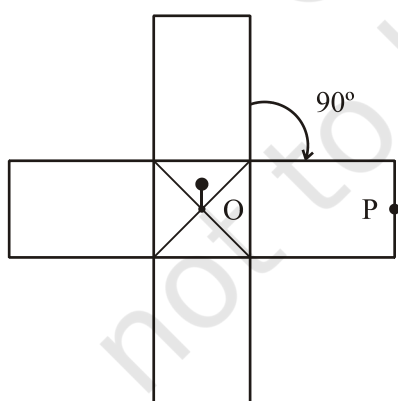
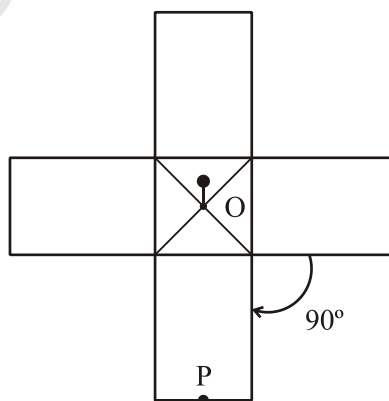
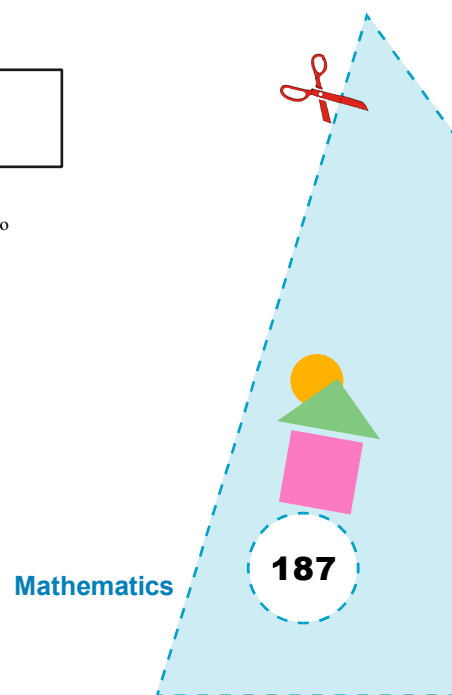
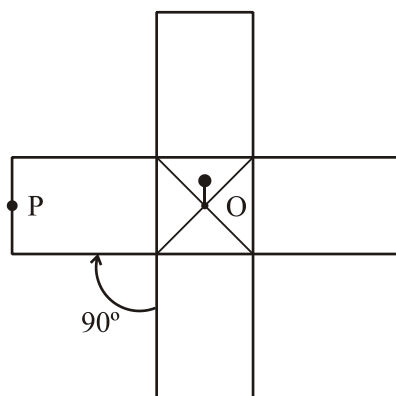
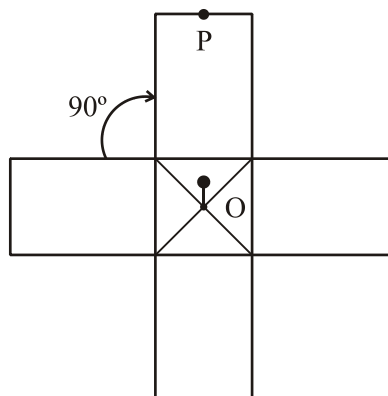



Fig. 6 *Fig. 7*

Observation

1. The upper figure coincides with the original figure after a rotation of ____, ____, ____ and ____. The angles of rotation are ____, ____, ____, ____.

2. Number of times the upper figure coincides with the original figure is = ____.

Order of rotational symmetry = _____.

Application

This activity can be used to determine the order of symmetry of different figures such as equilateral triangles, parallelograms, squares, rectangles etc.